The Planters' Chronicle.

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THE U. P. A. S. I.

(INCORPORATED.)

Contents.

The different methods of the preservation of Cattle manure, and their results will be read with interest by those who have followed much the same experiments published in the *Chronicle* from time to time.

In the correspondence columns will be found some letters which have been circulated by the Secretary to all Councillors.

It will be noted that it appears only one Railway gives a concession on Tea seed as regards freight, but the Tea Association have kindly taken the matter up, and we trust that their efforts will prove successful.

The Government of India, in their reply to the United Planters' Association's Resolution on the question of a remission of customs duty on ingredients used as insecticides and germicides, through Mr. Warburton, Secretary to the Chief Commissioner of Coorg, notify that they are unable to accept the Resolution.

The Joint Secretary to the Government of Madras, in reply to the Resolution forwarded on the subject of the Arsikere-Mangalore line, informs us, that His Excellency the Governor in Council is in favour of the early construction of this line. With such powerful support, it is hoped that the South Mysore Planters continually expressed desire, will at no great distance of time, become an accomplished fact.

We have much pleasure in publishing Mr. Mead's letter on the Labour Commission. To those who are earnest supporters of the proposal, Mr. Mead's last few lines will bring hopes that he may by it be persuaded to become a convert—we trust a willing one—for a man convinced against his will is of the same opinion still.

The Hon'ble Mr. Gosset's description of the visit to Costa Rica, and the methods employed there will be read with interest by all Coffee Planters.

We publish an interesting Lecture by Professor Dunstan, which should be carefully read by all Rubber Planters at this time when Rubber has fallen so low in price. He insists on the value of chemical research, thus emphasizing with his high authority, what has been so frequently insisted on in the pages of the *Chronicle*.

THE PRESERVATION OF CATTLE MANURE.

During the past eight years experiments have been conducted at the *Koilpatti Agricultural Station* with different methods of storing Cattle Manure. These experiments are now finished and it is concluded from the results that the action of Cattle Manure on cereal crops is largely mechanical.

The following results of the trials and the conclusions drawn from them are quoted from the *Annual Report* of the Station for 1912-13 as being of interest in connection with the work which is being done by the Scientific Department of the U. P. A. S. I. on Composts.

"*The relative advantages of different methods of preserving Cattle manure.*—Cattle manure preserved in different ways has been tested by applying it to plots of land in the black soil and comparing the yields one against the other as well as against no manure and other concentrated manures. The experiment has now been continued for eight years, except in one case where another method of preserving cattle manure has been tried only for the last three years. The land has been cropped with the normal four-course rotation of the district, *viz.*, first year, cholam; second year, cotton; third year, cumbu and fourth year, cotton

"The methods of preserving cattle manure which have been tested are as follows:—(1) *Box Manure.*—This is prepared by daily spreading the droppings of the cattle on the sunken floor of the cattle shed and allowing the cattle to tread on the manure. (2) *Byre Pit Manure.*—The cattle are tied in an ordinary shed with a masonry floor and the droppings are daily collected and put into a covered pit. The urine is also drained off the floor, collected and added to the solid dung in the pit. (3) *Heap manure.*—The cattle are kept in an ordinary shed and the solid excreta are thrown on to an exposed heap. (4) *The local method.*—This was introduced into the experiment only three years ago and is similar to the above except that the dung is thrown into a shallow pit and periodically covered with a layer of black soil. The figures of yields obtained from this last system are given in the statement of yields (Table V), but cannot be compared with the others as the plot had not been manured from 1903 until 1909 and the yields represent only the accumulative effects of three years application. Table IV of the appendix gives a statement showing the average for the last eight years of the actual weights of manurial ingredients applied per acre in lbs.

Table V of the appendix shows the average yields obtained from each crop and the annual average money value of the manure when compared with the no manure plot. The experiment has now been closed as far as the application of manures is concerned, but the yields from the plots are being registered for another rotation to find out the residual values of these

manures. The figures in the statement show clearly that the action of cattle manure is to a considerable extent mechanical, thus the shallower rooted cereals respond much more to those forms of cattle manure which contain most organic matter. Thus the box manure contains (calculated dry) 56·9% of organic matter. Byre and Pit manure 45·01%, and ordinary heap manure 38·87% and the table shows that the yields are greatest when most organic matter has been applied. The heap manure although it contains no urine shows a much higher rate of accumulation which averages 21·23 lbs. per day compared with Box manure 15·36 lbs. and Byre Pit manure 17·05 lbs. Thus it contains much more foreign inorganic matter besides which, being well weathered by exposure, it is in a much finer state of division and can therefore more readily become incorporated with the soil. That this has happened is shown by the yields of cotton obtained by the application of this manure. The heap manure has given an annual average yield of 805½ lbs. of kappas compared with only 752 lbs. from Box manure and 719½ lbs. from Byre and Pit manure. That the cotton crop cannot make use of all the cattle manure which contains more organic matter is indicated by the yields obtained this year when fodder cholam was grown and when this crop has to depend solely on the residue of the manure applied the previous year to cotton. This year's yields of fodder cholam given in the table show that these residues are very large and in the case of cattle manure are highest where most organic matter has been applied.

The yields obtained by the application of more concentrated fertilisers when compared with those obtained from the use of cattle manure show that in the case of the superphosphates and saltpetre, it is possible to obtain good yields of both deep and shallow rooted crops, especially as regards the straw of the latter, but we find that the cost of the manure absorbs all the profit obtained by the increased yield; while the residual value of the manure as shown by this year's fodder cholam crop is very small when compared to those of cattle manure. It is possible, however, that these manures being soluble have worked their way deeper into the soil and next year's cotton crop will show whether this is the case. With regard to Neem cake, this has given very good yields from shallower rooted cereals and has given higher yields of cumbu than any other manures applied. The yields of cotton, however, have never been high and the residual value of the manure is much less than that of bulky organic manures. These heavy applications of manure have a considerable effect on the quality of the kappas and in all cases the ginning percentage is from 2 to 3½ lower than in the case of the kappas from the no manure plot. The "local method" cattle manure is an exception, but this has only been applied for three seasons and not for eight seasons as in other plots. It is also a well rooted manure thoroughly incorporated with the black soil which has been added in the making and therefore is likely to work down deeper into the soil and thus render the cotton crop more drought resistant. In all the other cases, the manure is much more likely to remain near the surface and this would tend to form a development of a surface root system and this during the dry weather when the bolls are swelling would be likely to account for the low percentage of lint."

TABLE V.

Statement of the average crop Yields and their Values in the experiment to determine the Value of Cattle and other Manures. (Rotation :—1. Fodder Cholam, 2. Cotton, 3, Cumbu, 4. Cotton carried on for 2 full rotations.)

	Fodder cholam dry fodder in lbs. per acre.	Cotton following fodder cholam. Kappas in lbs. per acre.	Cumbu in lbs. per acre.		Cotton following Cumbu. Kappas in lbs. per acre.	Average annual money value of the manure as shown by the crop yield.	Residual Value of the Crop.	
			Grain.	Straw.			As shown by crop yields 1912—1913 crop fodder Cholam in lbs. per acre.	According to money value.
						Rs. A. P.		Rs A. P.
Box manure	4,365	696	623	2,416	807	23 3 0	5,263	29 5 7
Byre and Pit manure	4,229	632	606	2,169	807	20 12 6	5,194	28 10 7
Heap manure	3,801	756	514	1,580	855	22 8 1	4,232	19 0 8
Neem Cake, 1,000 lbs.	4,442	637	642	2,309	668	18 7 10	3,713	13 13 7
Superphosphate, 200 lbs. and Saltpetre 300 lbs.	6,168	742	517	2,190	787	27 2 11	3,162	8 5 5
No manure	3,323	425	280	595	460	.....	2,328	.....
Cattle manure—local method ...	...	713	462	1,122	589	.....	3,920	*15 14 9

Basis of money value :—Kappas ... 10 lbs. per Re. 1.
Fodder Cholam ... 100 „ „ „ 1.
Cumbu Grain ... 30 „ „ „ 1.
„ Straw ... 200 „ „ „ 1.

* Represents cumulative and residual value of only three years.

CORRESPONDENCE.

No. 1040-8.

Indian Tea Association,
Calcutta, 9th October, 1913.

THE SECRETARY,
United Planters' Association of Southern India.

Railway Freights on Tea Seed.

Dear Sir,—I am directed to acknowledge the receipt of your letter of 11th September forwarding copy of a resolution adopted in the above connection at the annual meeting of your Association held in August. So far as the Committee know, the only concession given in the matter of the carriage of tea seed by railways is that granted by the Assam Bengal Railway; on that line tea seed may be carried by passenger train at goods rate. The Committee are addressing the various other Indian railways with a traffic in tea seed asking that a similar concession should be given by them. I will write you in due course informing you of the result of the representations which the Committee are making.

Yours faithfully,
D. K. CUNNISON.

Import Duties.

No. 2588

From
P. B. Warburton, Esq., I. C. S.
Secretary to the Chief Commissioner of Coorg.

To
The Secretary,
United Planters' Association of Southern India,
25, South Parade, Bangalore.

Dated, Bangalore, 16th October 1913.

Sir,—With reference to your letter, dated the 11th September 1913, addressed to the Secretary to the Government of India in the Legislative Department, recommending that a remission of customs duty should be granted on all ingredients used as insecticides and germicides imported by approved firms for *bonâ fide* agricultural purposes, I am directed to inform you that the Government of India have given their careful consideration to the proposal but regret that they are unable to accept it. The general tariff rate of 5 per cent is imposed solely for revenue purposes and the Government of India have definitely adopted the policy of refusing all applications for exemption from the general duties imposed by the Tariff Act save in very exceptional circumstances. In the opinion of the Government of India, the tariff is already sufficiently liberal in the matter of concessions for agricultural purposes, and no further extension of these concessions is necessary.

I have the honour to be,
Sir,
Your most obedient Servant,
P. B. WARBURTON,
Secretary to the Chief Commissioner.

Government of Madras.
Public Work Department,
No. 1035 Rly—7.

Arsikere-Mangalore Railway.

From

Mr. S. D. Pears,
Joint Secretary to the Government of Madras.

To

The Secretary to the United Planters' Association of Southern India,
25, South Parade, Bangalore,

Dated Ootacamund, the 16th October, 1913.

Sir,—With reference to your letter of the 9th September last addressed to the Chief Secretary to the Government of Madras, I am directed to inform you that His Excellency the Governor in Council is in favour of the early construction of the Arsikere-Mangalore Railway and that the matter has been, for some time, engaging his attention.

I have the honour to be,
Sir,
Your most obedient Servant,

.....
For Joint Secretary. to Govt., P. W. D.

THE MOOPLY VALLEY RUBBER COMPANY, LIMITED.

Palapilly P. O,
S. India,
October 21, 1913.

Labour Commission.

The EDITOR,
The Planters' Chronicle,

Sir,—I waited for another issue of the *Chronicle* before replying to the numerous criticisms of my views on the Labour Question and the proposed Labour Commission.

First let me thank the various contributors to the discussion for letting me down so gently. Of Mr. Danvers it may truly be said, "Never a word didst thou mingle with gall." Mr. Danvers' letter seems to me to be rather an appeal for unanimity among South Indian Planters than an argument in favour of the utility and efficiency of the Labour Commission, and if it can carry the assurance that the establishment of a Commission would ensure us against the Labour Act and if it were certain that the support given to the Commission was practically unanimous, I would say, "Almost thou persuadeth me to be a convert."

Mr. Abbott asks me if I am pleased with the Labour situation. It seems to me that we must all judge this from the particular standpoint due to our actual environment. I personally class districts under three headings (1) The District such as this, which has not such a thing as a labour question and which I personally believe will never feel competition from any source. When one could easily double one's area in three years, clean

weed every acre, provide tapping coolies and avoid bad debts, one is naturally loathe to ask one's directors to sanction a large annual expenditure. (2) The second class of district is I thing the most common. This is a District where the labour is generally pretty sound. In such a district the bulk of the labour is drawn from one or two sources. The coolies employed come up year after year to the district if not to the same estate. Some estates have heavy advances outstanding, others have small advances which are real assets, i e., annually recovered. The different state of the advance accounts on different estates is generally the difference of the management over a period of years. I confess that there is generally a shortage of labour at different times of the year but this is due to climatic conditions rather anything else. The rushes of leaf at certain times makes a huge labour force necessary if other works such as weeding are to be attended to at the same time. (3) The third class of district is one where for one reason or another the labour conditions are frankly unsatisfactory. Such a district has probably tried every conceivable source of supply and has advances out in all directions. If such a district employs Canarese South Canara coolies, Coimbatore and Erode Tamils, Malabar Malayalams (sic) Moplahs, Panniars Curumbas, Badagas, it is quite obvious that to provide a commission to effectually control these sources of labour will be an expensive affair. The question is, should a district like the first I referred to be asked to contribute towards its cost? Further will the establishment of a commission really put matters right? Would not the money spent on the Commission produce more result if it were spent in encouraging one suitable class of labourer say the Canarese? In no district that I know of will you find all estates equally flush or short of labour. I have seen two adjoining estates, one full of labour with all advances sound, the other in a semi-abandoned state and with an advance account that was appalling. The moral is clear. It is management and continuity of management that is the biggest factor in the labour question, and if agents and proprietors would recognise this and not continually shift their men from one place to another there would be less bad debts and better labour on most places.

Mr. Duncan tells me that we will have to raise rates. I know nothing about the Anamalais, but I think in many cases rates are too low. When I am told that a district has cheap labour, I like to look at their cost of production and their advance accounts before I agree.

The Hon'ble Mr. E. F. Barber has convicted me of heresy. Though convicted by the voice of the multitude I am still a heretic. I can instance many estates which were more economically worked as private estates than they ever have been since they were put into a company. I still think that a district of the second order, or possibly two districts, adjoining each other and both drawing labour from the same centres could look after their labour cheaper than if they subscribed to a central commission and would keep in closer personal touch with the smaller commission and their labour.

I am opposed to a commission for this district because I consider it a waste of money, and I have grave doubts whether the establishment of a central commission will prove a panacea for the labour ills of a district in the third category, nor do I think that the money spent on the commission in such a case would be money spent to the greatest advantage. Such is my Credo.

If, however, the support accorded to the scheme proves to be nearly unanimous, the fact that the commission would protect us in great measure

from the depredations of the recruiter for countries over seas, help us a little with the actual forwarding of coolies and give us undoubted assistance with regard to remitting money to the villages, I should consider that I was getting some return for my money. This and Mr. Danvers' advocacy for unanimity and the hope of the U. P. A. S. I. carrying more weight with the different Governments would probably persuade me to advocate coming into line. Whether it would equally convince directors and the shareholders I cannot say.

I am Sir,
yours etc.,
A. H. MEAD.

October 10th, 1913.

PLANTERS' ASSOCIATION OF MALAYA MEETING.

FREIGHT ON RUBBER.

The Secretary said that as instructed he had written to the Rubber Growers' Association regarding the freight levied by the Straits Homeward Shipping Conference on rubber from the Malay Peninsula, and the general feeling seemed to be that with the present very considerable reduction in the intrinsic value of the commodity, the rates charged, when compared with those on other goods of equal bulk and value, were extremely unfair.

The R. G. A. had replied enclosing correspondence they had with the Shipping Conference on the subject, in which the latter refused to accede to their request for a reduction. The Shipping Conference pointed out that it was not intended in their letter of March 6 to indicate that the rate of freight was fixed on the particular value then existing, and that whilst due note was taken of the present reduced value it was considered that even such, in comparison with the values and rates of freight on other commodities, fully justified the present rates. It was further mentioned that the rates of freight from Para quoted in the previous letter were still in operation.—*Penang Gazette.*

SUB-SOILING BY DYNAMITE.

In response to a request for information as to how long the effects of sub-soiling by dynamite will last, Mr. R. B. Howard has furnished the result of his and of American experience in this regard. He says:—

'Some five years since I used the dynamite to drain a small depression or Swamp, which, previous to using the explosive, was always very wet—in fact, quite a morass. So far, the place has drained well, and, apparently, the fractures have not silted up. Again, I understand that in Victoria similar operations to those carried out by me were performed some ten years ago, and, so far, it has not been found necessary to renew the work. In America, from what I can gather from the various publications, it would appear that no attempt has been made to renew the operation, although, in some instances, the explosives had been used fifteen years previously. Personally, I hold the opinion that the constant percolation of the water will, in most kinds of soil, be sufficient to keep the soil open for very many years. Of course, in the case of fruit or other trees the roots would assist in maintaining the drainage caused by the explosive. The practice followed out by me when sub-soiling is to use the explosive once only, and, if properly carried out, I do not think it would be necessary to repeat the operation for at least ten years, and probably for a much longer period.—*The Queensland Agricultural Journal.*

COFFEE.

Coffee Plantations in Costa Rica.

The Hon'ble B. S. Gosset describes a visit he paid to some Coffee plantations in Costa Rica in the last issue of the *Bulletin of the Department of Agriculture*, Jamaica, to hand and the following extracts are taken from his interesting article.

"The Coffee fields on the older plantations are situated mostly on levels or easy slopes as the cherry coffee is carried from the fields in carts or on mule or horse backs to the works, or to tanks from which it is spouted to the pulping house and carried from the receiving tank in concrete gutters to the pulpers.

"Great care is taken with the nurseries which are kept like large vegetable gardens. The best seeds are sown in long beds and, when large enough, the seedlings are pricked out in regular rows and kept weeded till fit to plant out. New clearings are made from forest land, and the clearings are not burned but the limbs of the trees are lopped and packed in rows 12 feet wide and let to slowly rot by natural decay. The coffee is planted in rows 12 feet wide and the plants are put 6 feet apart in the row. No hoes are used for weeding but a *machete is* used to shave the weeds with about half an inch of soil away from the stems of the coffee and deposit them in the centre of the row. This machete is like a thinrick knife used for cutting hay and it is held in both hands and used most skilfully. The weeding jobs are calculated by the thousand and cost about 8s. per acre. Now and then when the weeds are rotted in the centre of the row they are thrown up round the stems of the trees to prevent exposure of the roots.

"Moderate shade is used at high elevations. Plantains are planted in the central rows and also a species of Guava which grows to a large size for shade. The latter trees are lopped when their shade is too dense and the loppings used as a mulch for the coffee.

"There is no pruning. The young trees are stumped about 18 inches from the ground and two or three suckers are allowed to grow which in crop bend down. The crop is picked by women and girls. The usual price for picking was six pence for a cuela; 20 cuelas go to a fenega which is expected to give 112 to 120 lbs. of cured coffee.

"Three Breast pulpers are used bedded in concrete. Two on a higher level pulp the cherry coffee which is led from the receiving tank by concrete gutters into the hoppers of the pulpers, and the pulped coffee is carried by water into a rotary iron washing screen or cylinder which separates the small beans and tails and these are carried into a third pulper and pulped over. The parchment coffee is in consequence even in size, as it is sized by the screen, and it can be more easily cured.

"The pulped coffee is carried by water into concrete fermenting tanks of which there are a large number. When fermented it is carried in broad shallow concrete gutters which wind backwards and forwards at an easy gradient for a considerable distance and washed in these gutters by men with wooden racks in a very simple and easy fashion. When sufficiently washed it is let out on the barbecues from a delivery tank and the water dried out of it by the sun. Some places use centrifugals to get the water out more quickly. It is then put into a rotary guardiola drier and kept going for about 48 hours when it is fit for shipment. Too hasty drying with too great heat spoils the quality.

"Most of the labour is done by white Peons of Spanish descent, a very reliable class. The current rate of pay is 2s. 6d. a day and they work in a steady way and need no driving."

RUBBER.

We reproduce from the India Rubber Journal an interesting lecture by Professor Wyndham R. Dunstan, F. R. S., Director of the Imperial Institute, on some chemical problems and the need of organisation in the Plantation Industry :—

"Professor Dunstan, having referred briefly to the rapid extension of the rubber industry in recent years due to the use of rubber tyres for motor vehicles—to the large amount of British capital embarked in the plantation companies, and to the large increase in production which had taken and was taking place, said the whole subject was an important one, and its success depended largely on scientific and technical investigation. Continuing he said: I cannot do better this evening than mention some of the principal facts and problems affecting the rubber industry, facts which must be realized by all those taking part in the advancement of the industry and problems which will only be solved by those who bring sound knowledge and scientific principles to the task. I assume most of those who will attend this course will look for employment as chemists in rubber factories in this country or on the plantations, where in future there will no doubt be openings for the employment of thoroughly qualified men. First, let me remind you that the most important rubber tree is Hevea brasiliensis, which in its wild state furnishes the greater part of the rubber output of South America, and in its cultivated state the output from the East, etc.

"Manufacturers assert that plantation Pará Rubber is in general, inferior to the best wild Pará rubber, being often deficient in strength and other useful qualities, and this inferiority is reflected in the lower price of plantation rubber as compared with the highest grade of fine hard Pará from South America. It is, however, admitted that some plantation rubber has proved to be equal to fine hard Pará. In dealing with this important problem of the quality of plantation rubber several factors have to be taken into account. The age of the tree undoubtedly affects the physical properties of the rubber, and most plantation trees are very much younger than the wild trees of the Amazon. The plantation tree is tapped more regularly and in general more often than the wild tree of the Amazon, and we have yet to ascertain precisely the effect of frequency and method of tapping on the quality of the rubber. The method of coagulating the latex and preparing the rubber of the wild tree differs from that followed in plantations. The Brazilian method is primitive and crude, and can no doubt be improved upon, and in perfecting the plantation method much may be learnt from a detailed examination of the Brazilian method, in which the latex is coagulated on a stick in the smoke of burning oil nuts, the coagulum of rubber being wound in layers on the stick until a large ball is obtained. One of the chief components of the smoke is acetic acid, which is usually employed as such to coagulate the plantation rubber, liquid acetic acid, being added to the latex, and the coagulated rubber being subsequently smoked in some cases. It is, therefore, apparent that in solving the problem of the cause of the alleged inferiority of much of the plantation rubber all these differences will have to be taken into account, and that scientific methods of investigation must be relied on in order to ascertain the facts. The truth is that the growth of trees in plantations and the continuous production of rubber from them is an entirely new undertaking, and presents special problems and difficulties which do not arise in connection with the wild trees of the forest. These problems and difficulties provide material for investigation by scientific specialists, by well trained chemists, botanists, mycologists and entomologists.

I now turn to other problems which again chiefly concern the chemist who has educated himself to be a rubber specialist. How is the composition and the quality of raw rubber to be judged? Raw rubber consists of the elastic constituent, caoutchouc, mixed more or less with certain impurities, principally composed of other constituents of the latex of the tree, which have become included in the rubber during coagulation and which have not been removed during the subsequent washing and preparation. These impurities are chiefly resins and proteids derived from the latex, together with water and small quantities of mineral constituents. At present no satisfactory method has been advised for estimating the quantity of the important constituent caoutchouc in the variable mixture known as raw rubber as it comes from the Tropics. The present practice is to determine the quantity of each of the impurities and to reckon the difference as caoutchouc. Thus, if it is ascertained that in 100 parts of rubber there are 1·6 per cent. of resin, 2·1 per cent. of proteids, and 0·3 per cent. of mineral constituents—that is 4 per cent. of impurities in all—it is assumed that the remaining 96 per cent. is caoutchouc. The errors in the determination of the impurities are therefore reckoned as caoutchouc. There is, moreover, evidence that what is regarded as caoutchouc in the calculation is not always a chemically homogeneous substance, and that attention will have to be paid to the precise nature of the chief constituent. Having regard to the approximate character of rubber analysis as at present conducted, and especially to the probability that what is called caoutchouc may not always be one and identically the same substance, it is not surprising to find that two specimens of rubber which ordinary analysis shows to be of the same composition, may nevertheless differ in physical properties and not prove to be of the same quality for manufacturing purposes.

Some people have gone so far as to assert that chemical analysis is useless for the purpose of determining the quality of rubber. The truth is that an accurate method of chemical analysis has yet to be devised. This must not only include a direct method of determining caoutchouc, but one which takes account of possible differences in the composition of caoutchouc owing to the presence in it of other but probably very nearly related substances. Holding as I do the view that the coagulation of the rubber latex is wrongly classed with the coagulation of milk, and that the change from the liquid of the latex to solid rubber is more akin to the processes known to the chemist as polymerization and condensation, it would follow that light is likely to be thrown on this important question by a fuller examination of the chemistry of the latex as well as of the separated caoutchouc. By this means we may discover not only an accurate method of direct analysis, but also the cause of the variation in the strength of different rubber and the best method of preparing rubber with the greatest strength.

In view of the present defects in methods of chemical analysis, physical tests have been resorted to in order to determine differences not disclosed by analysis. The tests of tensile strength and elasticity are best made on rubber after vulcanization, and not before it, since vulcanized rubber is the form chiefly employed by the manufacturer. The determination of the viscosity of raw rubber solutions affords, however, a promising method of guaging the quality of raw rubber, since viscosity is a property which apparently may be correlated with strength and other valuable characteristics of the material. At present, however, the determination of viscosity of a rubber solution cannot be wholly depended on as a satisfactory indicator of the quality of rubber, although further research in this direction is well worth pursuing. Tests of the physical properties of the vulcanized rubber

are all present probably the most useful in determining the quality of rubber, but in this region also much work remains to be done before entirely satisfactory methods can be perfected. The problem of determining directly the precise proportion of true caoutchouc present in raw rubber by chemical means will, however, in course of time be solved in this, as it has been in other cases. Fundamentally the physical properties of a given substance must depend on composition, and the exact determination of composition is the province of the chemist, I must not omit to mention that there are some who hold the view that the failure of chemical analysis alone to gauge the value of raw rubber depends on the fact that the so-called impurities, particularly the resins and proteids, contribute to make the value of the material. This, in my opinion, is unproved, but even if it were proved, the importance of the chemical research to which I have referred would not be lessened. As a fact, most rubber is at present bought and sold, not as the result of any scientific test, but by the primitive method of judging by the eye and pulling by the hand to judge of elasticity and strength.

While alluding to the nature of caoutchouc, I may say a few words about artificial or synthetic rubber. It must be accepted as a fact that caoutchouc identical with that obtained from the rubber tree can be produced by the chemist by purely laboratory processes and without the aid of the living plant. It only remains to perfect the process so as to obtain caoutchouc of the greatest strength and elasticity. As I pointed out seven years ago, this fact must be accepted, and the practical question is whether this synthetic rubber can be produced as cheaply as the rubber extracted from the tree. The answer to this question to-day is undoubtedly in the negative, and, with the prospect in the near future of large quantities of natural rubber being produced at a cost of less than one shilling a pound, the chances that synthetically produced rubber can compete against it commercially appear to me to be remoter than ever.

"Among other chemical problems awaiting solution of the precise differences in the composition of the latex induced by frequency of tapping a rubber tree at different seasons and periods of growth and in different ways. This is a problem that cannot be successfully attacked until more is known as to the chemical variation of "caoutchouc" and an accurate method of determining it has been devised. A curious and unfortunate property which rubber sometimes shows is that of "stickiness," when the rubber is said to be, "tacky." This property is sometimes observed in freshly prepared rubber, and at other times gradually makes its appearance in sound rubber. The origin and nature of "tackiness" have not been fully explained. Most of the problems which await scientific investigation, to which I have so far referred, relate to the production of rubber in the plantation or its preparation in the Tropics, and some of these can only be thoroughly investigated on the spot. There is, however, a rich field for investigation of a more technical kind in connection with the manufacture and uses of rubber. The process of vulcanization is at present not fully understood, and is no doubt susceptible of improvement. That rubber chemically combines to some extent with sulphur during vulcanization there can be no doubt, but in order to vulcanize successfully much more sulphur has to be added than the rubber can combine with, and the part played by the so-called uncombined sulphur is at present obscure. The uses of rubber are confined to a few industries, of which the most important is the manufacture of tyres.